CALIBRATION LAB

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DOCUMENT CONTROL ADMINISTRATOR

INSTRUCTION MANUAL

MODEL 26120

LOG PICOAMMETER

warranty

We warrant each of our products to be free from defects in material and workmanship. Our obligation under this warranty is to repair or replace any instrument or part thereof which, within a year after shipment, proves defective upon examination. We will pay local domestic surface freight costs.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and shipping instructions.

repairs and calibration

Keithley Instruments maintains a complete repair and calibration service as well as a standards laboratory in Cleveland, Ohio. A service facility is also located in Los Angeles for our west coast customers.

A Keithley service facility at our Munich, Germany office is available for our customers throughout Europe. Service in the United Kingdom can be handled at our office in Reading. Additionally, Keithley representatives in most countries maintain service and calibration facilities.

To insure prompt repair or recalibration service, please contact your local field representative or Keithley headquarters directly before returning the instrument. Estimates for repairs, normal recalibrations and calibrations traceable to the National Bureau of Standards are available upon request.

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SPECIFICATIONS

RANGES: Selection of three single scale models.

Models	Range Span Ampere	Input Polarity	Decade Span	Calibration Points Ampere
26120	10^{-3}-10^{-11}	See note *	8	10^{-4}/10^{-10}
26220	10^{-4}-10^{-12}		8	10^{-5}/10^{-11}
26320	10^{-7}-10^{-13}		6	10^{-8}/10^{-11}

OVERALL OPERATING CHARACTERISTICS:

TEMPERATURE COEFFICIENT: Less than 2%/°C referred to input current from +10 to +30°C.

RISE TIME: Seconds to 90% of final current value. (DAMPING control at minimum setting):

Models	Current Change Ampere	With No Significant Capacitance Across Input Terminals	With 5000 pF Capacitance Across Input Terminals
26300	10^{-13} to 10^{-12}	3 seconds	6 seconds
All	10^{-12} to 10^{-7}	1 second	2 seconds

LINEAR-LOG RELATIONSHIP: Ideal: $E_o = M \log I + C$. Actual: E_o actual will deviate from the best straight line by less than 10 mV (where M = slope and C = offset of transfer function). **

OUTPUT: 1 volt per decade from minimum current to maximum current. Output is always positive.

CONNECTORS: Input: BNC type. Output: Microphone receptacle, XLR-3-32 (connectors located on rear panel).

POWER: 90-125 volts or 180-250 volts, 50-60 Hz.

ACCESSORIES SUPPLIED: Set of mating connectors.

DIMENSIONS, WEIGHT: 5½" (140 mm) high x 8¾" (222 mm) wide x 13" (330 mm) deep; net weight, 8 pounds (3,6 kg).

*Output is positive for all inputs.

**40 mV at 10^{-12}A, 300 mV at 10^{-13}A

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SECTION 1. GENERAL INFORMATION

1-1. GENERAL. The Model 26000 log picoammeters provide a logarithmic scale which covers a wide range of currents without switching. Current measurements are easily performed since the picoammeter can be directly connected to phototubes, photomultipliers, ion vacuum gauges, ionization chambers, and automated semiconductor testing equipment.

1-2. FEATURES. The Model 26000 is designed to allow the user to select the instrument which most closely meets the measurement needs. Standard features include an easy-to-read mirrored meter scale, a recorder output, an overload recovery switch, and a front panel calibration check switch. On dual polarity units, two front panel lamps are used to indicate the polarity at the input.

1-3. OPTIONS. The options available for factory installation on the Model 26000 include an internally installed bias supply, and negative or dual polarity.

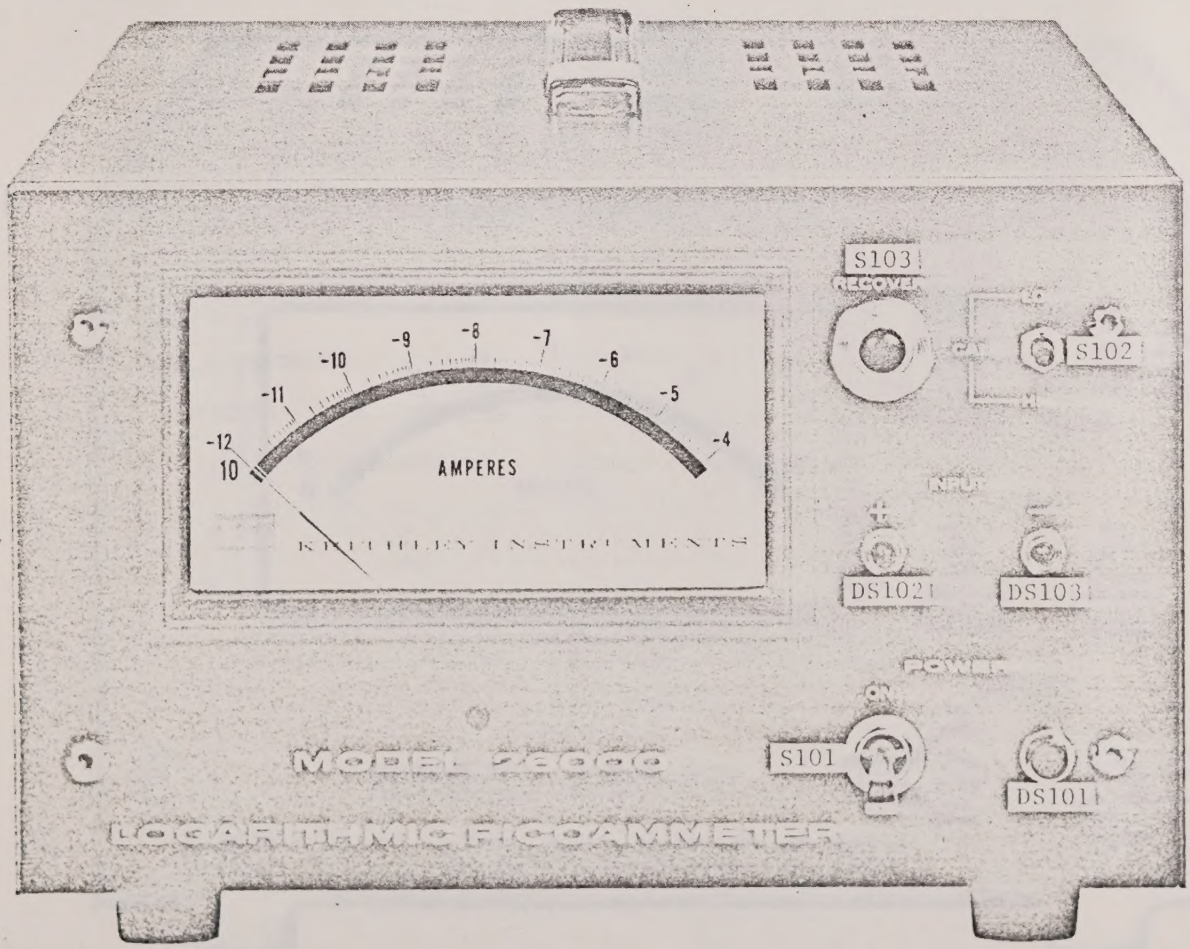
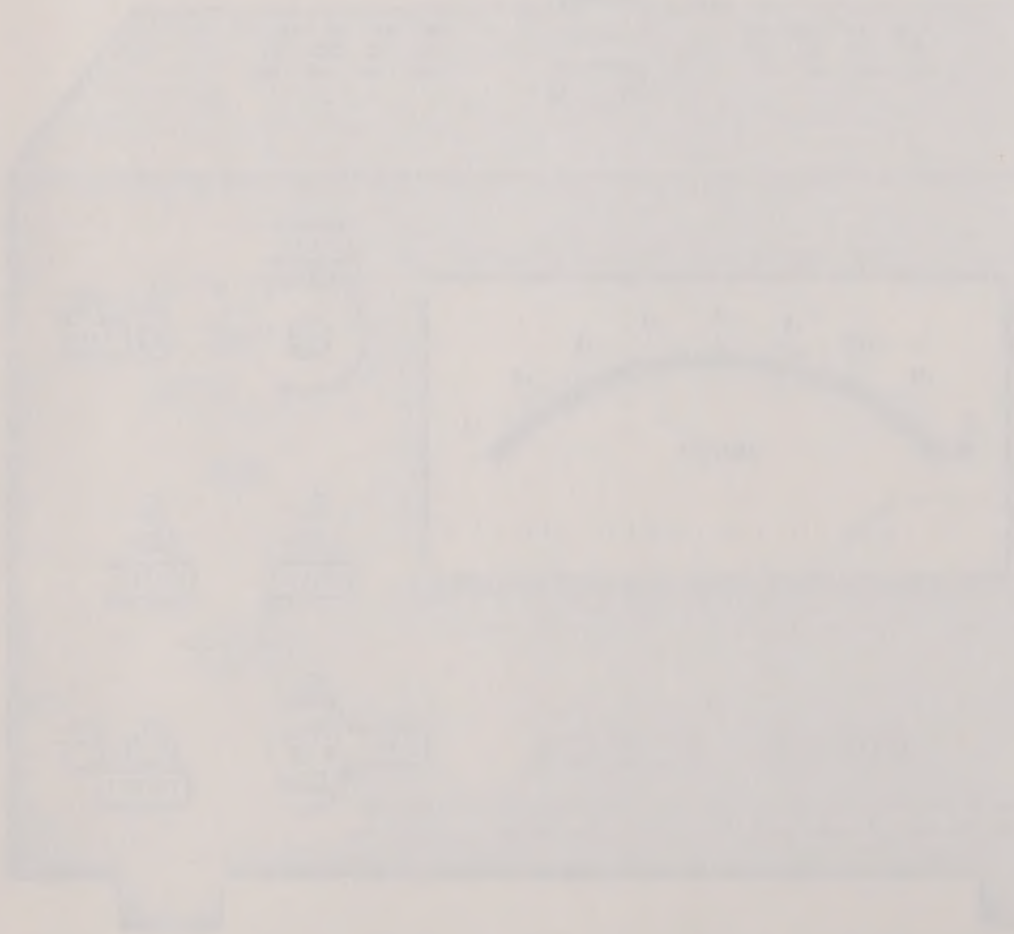


FIGURE 1. Front Panel. (Model 26220 shown).



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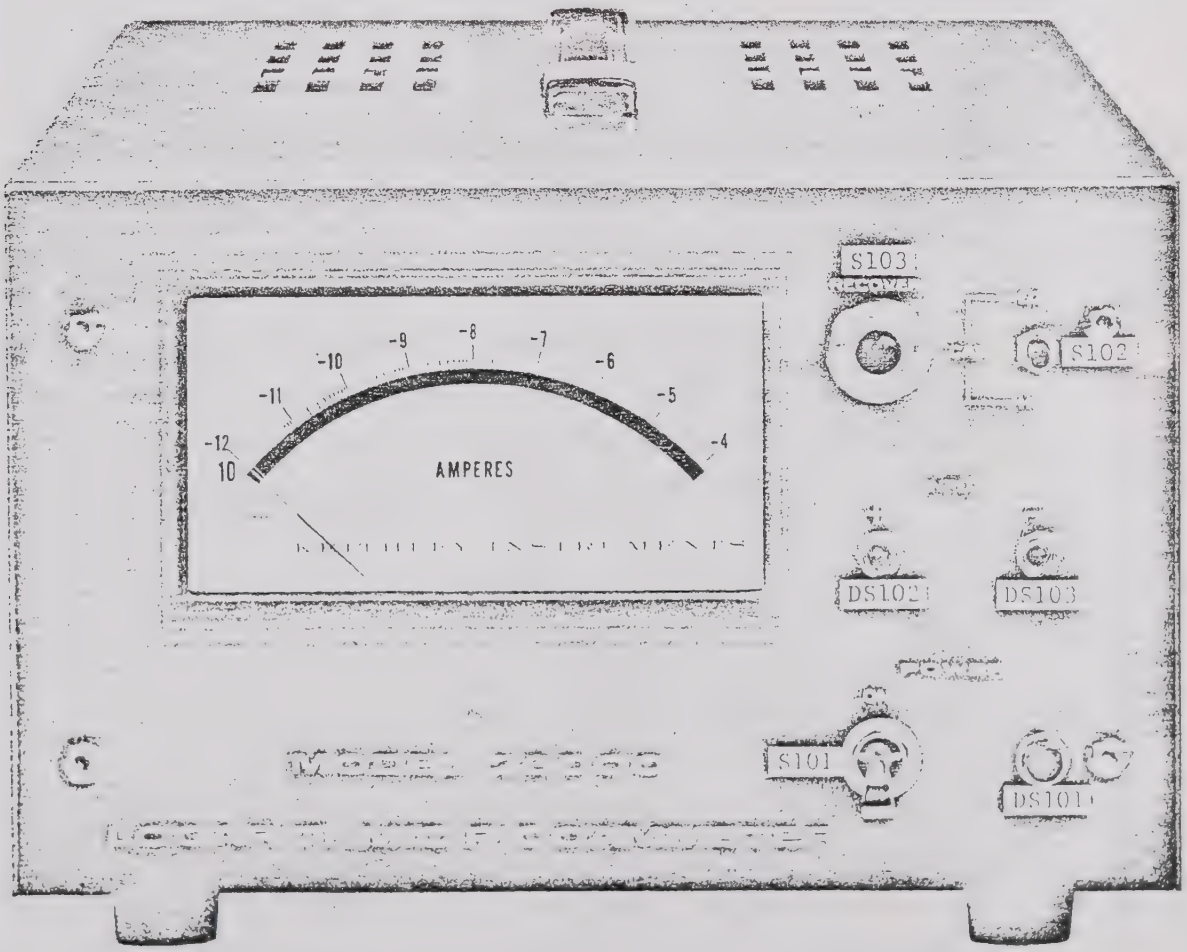


FIGURE 1. Front Panel. (Model 26220 shown).

SECTION 2. OPERATING INSTRUCTIONS

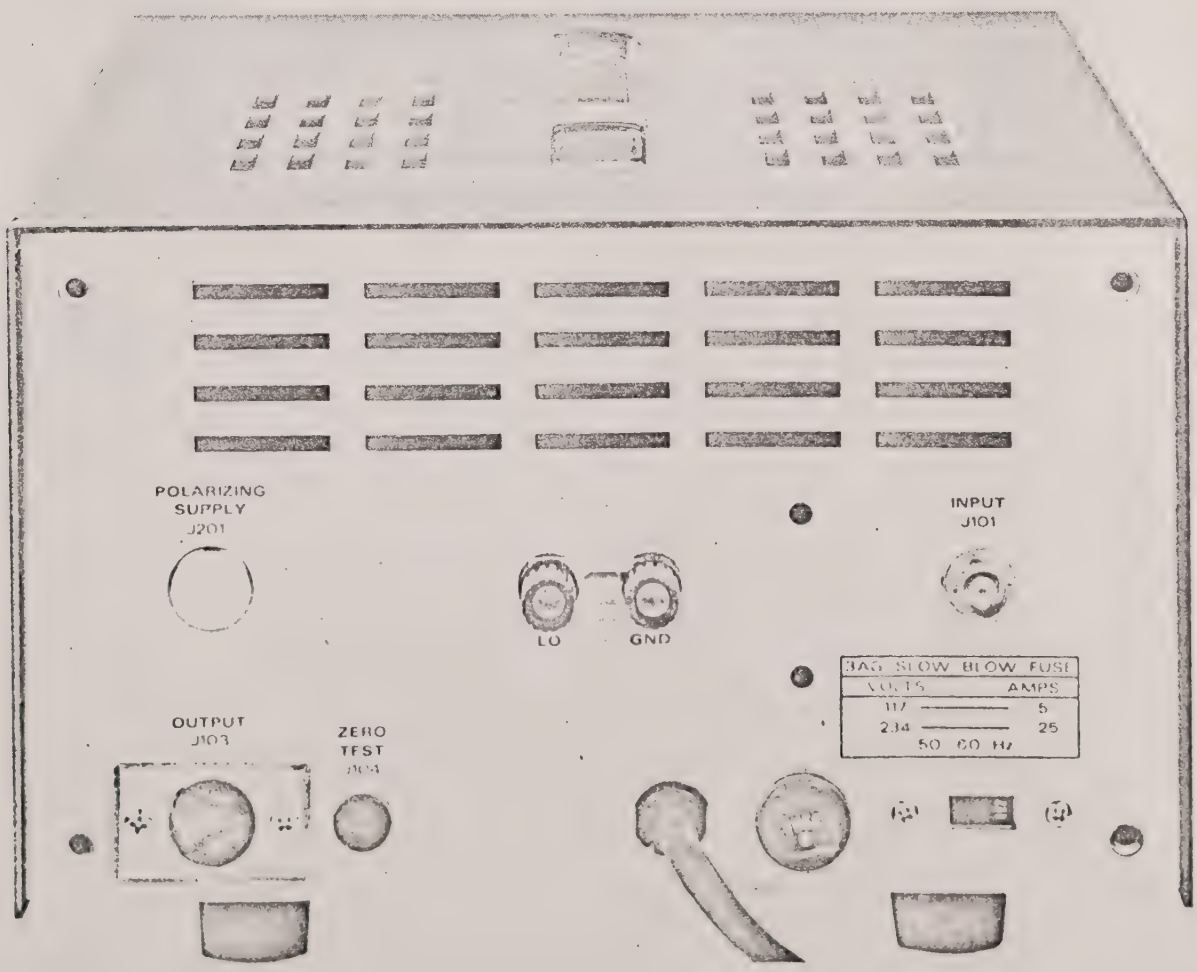
2-1. GENERAL. This section describes the procedures for operating the 26000 series log picoammeter with the following features:

a. Range Span. Meter scale has eight decades from 10^{-3} to 10^{-11} ampere.

b. Input Polarity. Front panel meter indicates up-range for all input polarities Analog output polarity is positive going for all inputs.

c. Analog Output. Rear panel output is 1 volt per decade from minimum current to maximum current. Maximum output is +8 volts corresponding to an input of $+10^{-3}$ampere Pin 3 on the output connector is the polarity indicator. Pin 1 is the signal output.

d. Schematics. The following schematic numbers are used with this instrument: 25951C, 25952B, 25953D.



2-2. CONNECTIONS.

a. Input. The Model 26000 has a single BNC type input connector on the rear panel. The mating connector is an Amphenol 31-002 BNC plug (Keithley part no. CS-44). The accessory Model 8202 cable (20" long) mates with the BNC input and uses low-noise coaxial cable. The Model 26000 also provides separate terminals for input LOW and chassis GROUND. A shorting link is supplied for optional chassis ground or other system ground connection.

b. Output. The Model 26000 has a single 3-pin connector on the rear panel for the analog output. The mating connector is a Keithley CS-72 3-pin plug. The pins are designated as shown in Figure 3.

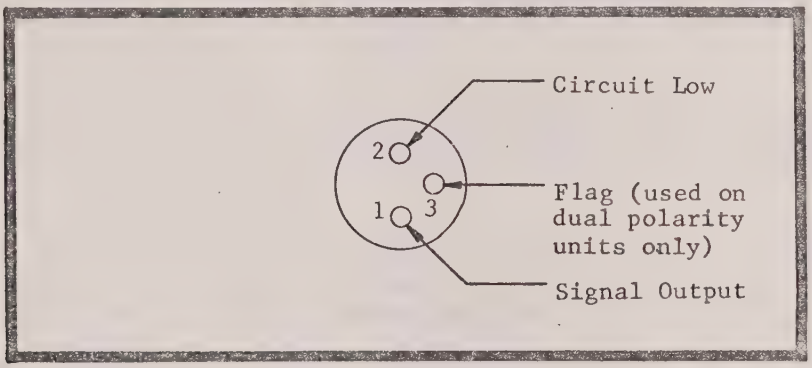


FIGURE 3. Recorder Output Connector

c. Power Input. The power cable is a 3-wire cord which is used with a standard 3-prong receptacle.

2-3. CONTROLS AND INDICATORS.

a. Power Switch. This switch controls the line power to the instrument.

b. Power Indicator. This indicator glows when power is on.

c. Meter Scale. This meter is calibrated to read directly in amperes. The unequal divisions between decade ranges are a result of the logarithmic characteristic of the instrument.

d. Calibration Check Switch. This switch has 2 positions: HI and LO. When the switch is set to the high position, the meter should indicate the proper high calibration current as in Table 2-1. When the switch is set to the low position, the meter should indicate the proper low calibration current as in Table 2-1. When the switch is in the center "off" position, the meter indicates normally.

e. Input Polarity Indicators. (Dual Polarity units only). These indicators show the polarity of the input current. The meter scale will always read up-range regardless of the input current polarity. Pin 3 on the rear panel recorder output also indicates polarity where Logic "0" = positive input.

f. Recover Switch. This switch removes the input current overload by shorting input High to Low and disconnecting the logarithmic amplifier allowing the input amplifier to come out of saturation when subjected to a severe overload.

g. Line Switch (Rear Panel). This switch sets the instrument for either 117 or 234 volt operation.

TABLE 2-1.
Current Reading at CAL CHECK Positions

Model No.	Range	HI CAL Reading	LO CAL Reading
26100	10^{-3} to 10^{-11}A	10^{-4}A	10^{-10}A
26200	10^{-4} to 10^{-12}A	10^{-5}A	10^{-11}A
26300	10^{-7} to 10^{-13}A	10^{-8}A	10^{-11}A

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2-4. CURRENT MEASUREMENTS.

a. Linear-Log Relationship. The Model 26000 provides an output which is proportional to the logarithm of the input current. The transfer function for the 26000 has the following form:

$$E_o = M \log I + C$$

where E_o = analog output voltage
M = slope or rate of change of voltage
C = offset of transfer function
I = input current

The exact values of M and C are a function of the calibration of a particular instrument. Typically the value of M is 1 volt per decade.

b. Meter Scale Interpretation. The front panel meter is calibrated on a logarithmic scale. The pointer indicates at the extreme left position with no current applied at the input terminal. When an input current is applied, the meter indicates the current in decade steps as denoted by the major scale divisions. The smaller divisions denote increments of a decade. The compactness of divisions of the meter scale is a result of the logarithmic response.

c. Recorder Output. The output of the 26000 is provided between pin 1 (signal) and pin 2 (low). The typical voltage at the output is 1 volt per decade. (See specifications for a discussion of accuracy of linear-log relationship.) On dual polarity units, pin 3 indicates polarity where Logic "0" = positive.

d. Recover Switch Operation. The RECOVER switch on the front panel is a momentary contact pushbutton which shorts the input High to input Low (thus removing the current overload at the amplifier input). In addition, the first log amplifier stage is brought out of saturation by a connection between input and output.

NOTE

A small meter offset may be indicated when the Recover switch is depressed. The pointer should return to extreme left position on the meter scale when the Recover button is released and no current is applied at the input.

SECTION 3. THEORY OF OPERATION

3-1. GENERAL. This section contains a description of the circuit theory of the Model 26000 Log Picoammeter.

3-2. LOG PICOAMMETER. The Model 26000 is a sensitive picoammeter with a built-in logarithmic response. The first stage of amplification is provided by a high gain amplifier with negative feedback. The logarithmic characteristic is obtained by utlizing a transistor as the feedback element. The transistor develops a voltage across the feedback of the amplifier which is proportional to the collector current. For a solid-state device, it can be shown that the I versus E characteristic of a P-N junction reduces to:

$$V = -2.3\frac{kT}{q}\log_{10} I + C$$

where V= voltage across junction (volts)
I= current through junction (amperes)
C= offset voltage
k= Boltzmann's constant
q= electron charge (coulombs)
T= temperature (^{o}K).*

The slope of the linear-log relationship is 2.3 kT/q which is approximately 59 mV per decade current change at 25^{o}C.

*NOTE

The Model 26000 incorporates special temperature compensating circuitry which reduces the effects of temperature variations in the log amplifier to a nominal level.

3-3. INPUT SWITCHING CIRCUITRY (SCHEMATIC 25952B). The input current applied to J101 is connected to the logarithmic amplifier through resistor R103 (which provides over current protection).

a. Recover Mode Switching. In this mode the input is connected to low through resistor R103. When the Recover Switch is depressed both relays K101 and K102 are energized. A connection is made in the feedback path of the log amplifier to pull the first stage out of saturation. (Resistor R102 is connected between the input at R102 and the output of QA101).

b. Low Cal Check. The input is connected to low through R103. Relay K101 is energized so that a calibrated current is applied to the log amplifier. The value of current is approximately the reciprocal of resistor R101. (See Table 3-1).

c. High Cal Check. The input is connected to low through R103. Both relays K101 and K102 are energized, so that a calibrated current is applied to the log amplifier. The value of current is approximately the reciprocal of resistor R102. (See Table 3-1).

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Model No	Range	HI CAL Reading	LO CAL Reading
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3-4. LOG AMPLIFIER CIRCUITRY (DUAL POLARITY VERSION, SCHEMATIC 25951C). The input current is applied to a high gain amplifier composed of a balanced MOS-FET input pair (Q103, Q105) and integrated circuit QA101. Transistors Q101 and Q102 are PNP/NPN types which provide the logarithmic characteristic. Each transistor is connected (collector to emitter) in the feedback of the first stage amplifier. Resistors R122 and R123 set the fractional feedback gain. Potentiometer R104 is a damping control for the log amplifier. The input amplifier is followed by two separate stages in parallel. When the output of QA101 is positive-going, the signal is amplified by transistor Q106 and integrated circuit QA103. Potentiometers R110 and R111 are gain adjustments which set the over-all gain to 1 volt per decade of input current. Potentiometers R109 and R112 are offset voltage adjustments. The output stage consists of a dual emitter-follower Q108 and Q109.

SECTION 4. CALIBRATION

4-1. GENERAL. The procedure given in this section may be used to assure the performance of the instrument within specifications.

4-2. TEST EQUIPMENT. The equipment shown in Table 4-1 is recommended for use in performing the calibration.

TABLE 4-1
Test Equipment

Description	Specification	Mfr.	Model
Current Source	10^{-14} - 10^{-4}A, .25-1.6%	Keithley	261
Digital Voltmeter	1μV-1000V, 0.03%	Keithley	171
Oscilloscope	---	Tektronix	561

4-3. ADJUSTMENT PROCEDURE.

a. Log Amplifier Zero. Connect the DVM between J104 (zero test jack) and LOW (black binding post) on the rear panel. Depress and hold the RECOVER Switch. Adjust the ZERO potentiometer R103 on the log amplifier module (as shown in Figure 4) for an output reading of 0.0000V ±0.5 mV. Once the amplifier zero is set further adjustments are usually unnecessary. Remove all test equipment connections in preparation for the next test.

b. Log Amplifier Gain & Offset. Locate resistor R103 on the log amplifier module. Connect a jumper across R103 as shown in Figure 5. Replace shield cover. Connect the DVM between pins 1 and 2 on J103. Use the oscilloscope to monitor the output for unusual oscillations, etc.

CAUTION!

Do not apply a large input overload current while R103 is shorted out. Remove the short circuit after making the necessary adjustments.

3-5. MAIN CHASSIS CIRCUITRY (SCHEMATIC 25953D).

a. Power Supply. The power supply module is a completely self-contained unit which provides ±15 volts dc. The input power is set by the rear panel line switch for either 117 or 234 V rms. 50-60 Hz. The supply is fused for 0.5 amperes at 117V.

b. Polarity Indication (Dual Polarity Units only). The front panel polarity indicators are switched by transistors Q110 and Q111. The + INPUT lamp (DS102) is turned on whenever the output of QA103 goes positive corresponding to a + input current. The - INPUT lamp (DS103) is turned on whenever the output of QA102 goes positive corresponding to a -input current. Transistor Q112 is connected for open collector logic to indicate polarity at pin 3 of the analog output. A pull-up resistor (R149) may be installed on the pc board for connection to the internal +5 volt bias.

Logic level "0"= positive input current.

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4-3. ADJUSTMENT PROCEDURE.

a. Log Amplifier Zero. Connect the DVM between J104 (zero test jack) and LOW (black binding post) on the rear panel. Depress and hold the RECOVER Switch. Adjust the ZERO potentiometer R108 on the log amplifier module (as shown in Figure 4) for an output reading of 0.0000V ±0.5 mV. Once the amplifier zero is set further adjustments are usually unnecessary. Remove all test equipment connections in preparation for the next test.

b. Log Amplifier Gain & Offset. Locate resistor R103 on the log amplifier module. Connect a jumper across R103 as shown in Figure 5. Replace shield cover. Connect the DVM between pins 1 and 2 on J103. Use the oscilloscope to monitor the output for unusual oscillations, etc.

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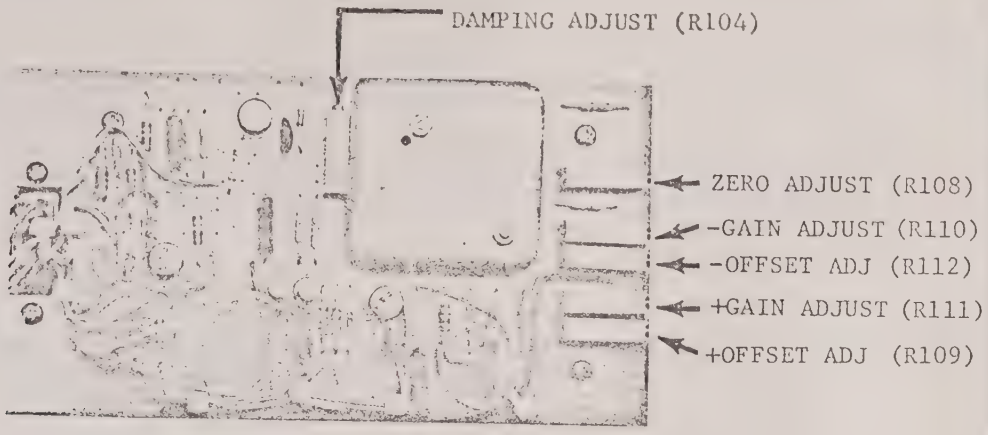
This revision is effective as of serial no. 1871.



NOTE: Previously manufactured models have a slightly different component location for R110, R111 and R112. (See Figure 7.)

FIGURE 4. Log Amplifier Module

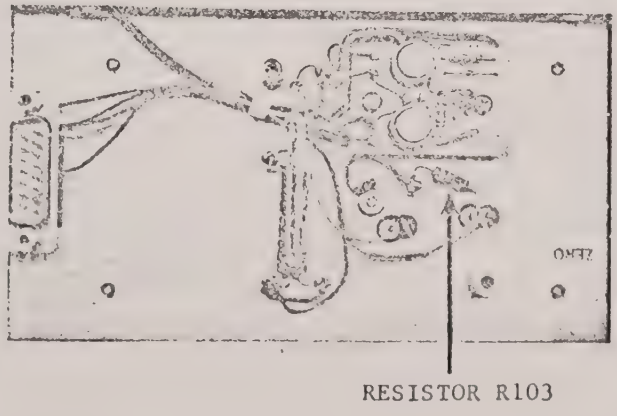


FIGURE 5. Log Amplifier (Bottom View).

1. Offset Compensation (Positive Input). Apply an input signal of $+1 \times 10^{-10}$A from the Model 261 Current Source. Adjust the + OFFSET potentiometer (R109) for +1.000V $\pm$ 10 mV at the output.

2. Gain Setting (Positive Input). Apply an input signal of $+1 \times 10^{-4}$A from the Model 261. Adjust the + GAIN potentiometer (R111) for +7.000 V $\pm$ 10 mV at the output.

3. Offset/Gain Interaction. Repeat steps 1 and 2 above to assure that both adjustments are within specified tolerance.

4. Offset Compensation (Negative Input). Apply an input signal of -1×10^{-10}A from the Model 261. Adjust the - OFFSET potentiometer (R112) for + 1.000V $\pm$ 10 mV at the output.

5. Gain Setting (Negative Input). Apply an input signal of -1×10^{-4}A from the Model 261. Adjust the - GAIN potentiometer (R110) for +7.000V $\pm$10 mV at the output.

6. Offset/Gain Interaction. Repeat steps 4 and 5 above to assure that both adjustments are within specified tolerance.

c. Damping. This adjustment should be made to suit the response needed by a particular measurement. The DAMPING ADJUST potentiometer (R104) provides increased damping by clockwise adjustment. Adjustment counterclockwise decreases damping. Since source capacitance can affect the stability of the instrument the damping adjustment should be checked prior to measurements in which a change in cable, etc., has been made. Oscillations may occur if damping is insufficient for source conditions.

SECTION 5. REPLACEABLE PARTS

5-1. GENERAL. This section contains information for ordering replacement parts. To place an order or obtain information concerning replacement parts, contact your Keithley representative or the factory. When ordering parts, include the following information:

a. Instrument Model Number

b. Instrument Serial Number

c. Part Description

d. Circuit Designation (if applicable)

e. Keithley Stock Part Number (if applicable)

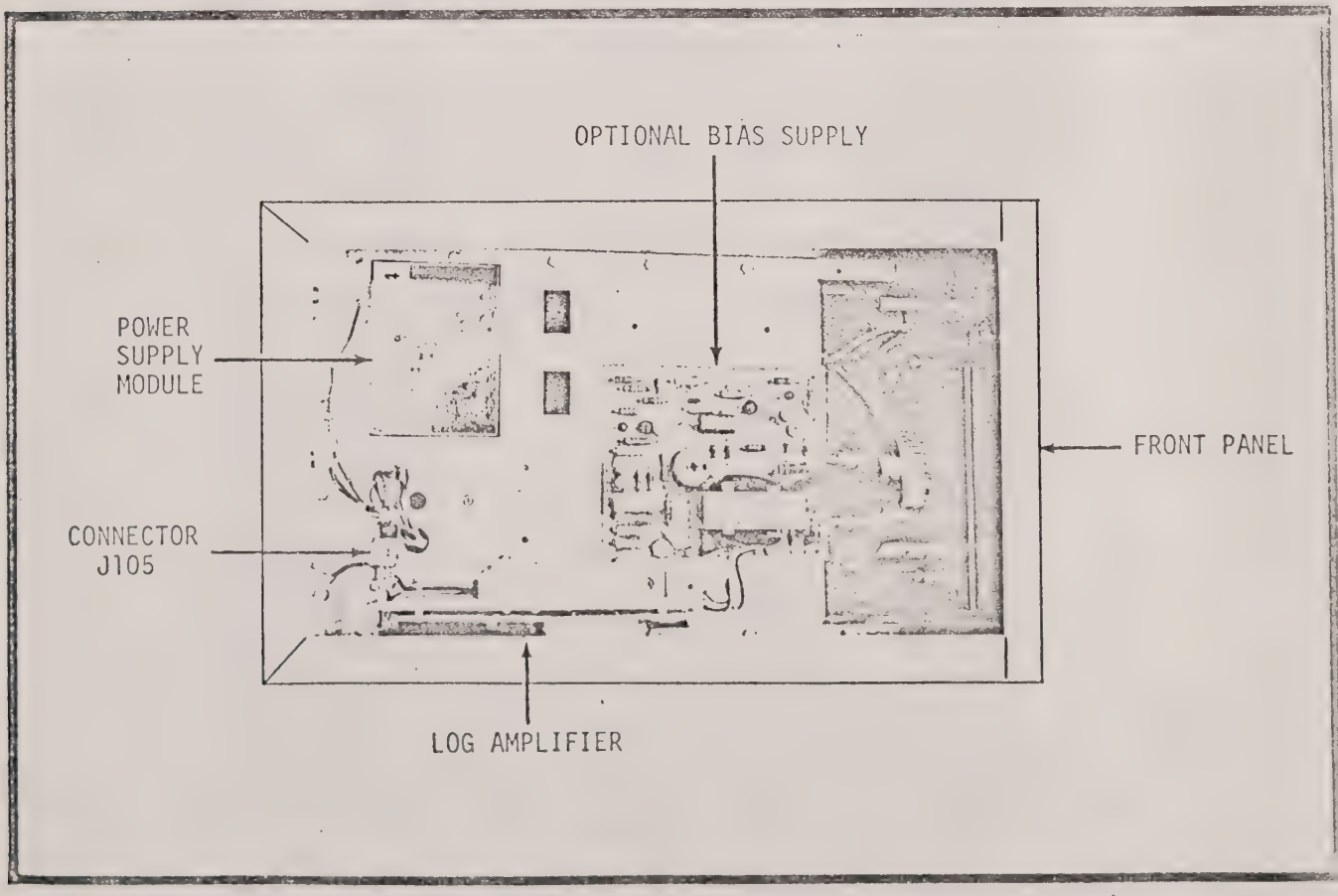


FIGURE 6. Top View of Chassis (shown with Bias Supply Option).

REPLACEABLE PARTS LIST
MAIN CHASSIS (SCHEMATIC 25953D)

RESISTORS

Circuit Desig.	Value	Rating	Type	Mfr. Code	Mfr. Desig.	Keithley Part No.
R140	68KΩ	10%, 1/4W	Comp	A-B	CB68K-10%	R76-68K
R141	68KΩ	10%, 1/4W	Comp	A-B	CB68K-10%	R76-68K
R142	33KΩ	10%, 1/4W	Comp	A-B	CB33K-10%	R76-33K
R143	33KΩ	10%, 1/4W	Comp	A-B	CB33K-10%	R76-33K
R144	470Ω	10%, 1/4W	Comp	A-B	CB470-10%	R76-470
R145	47KΩ	10%, 1/4W	Comp	A-B	CB47-10%	R76-47K
R146	100KΩ	10%, 1/4W	Comp	A-B	CB100K-10%	R76-100K
R147	10KΩ	10%, 1/4W	Comp	A-B	CB10K-10%	R76-10K
R148	4.3KΩ	10%, 1/4W	Comp	A-B	CB4.3K-10%	R76-4.3K
R149	Not Used	------	----	----	--------	--------
R150 (26120)	127KΩ	1%, 1/2 W	MtF	IRC	CEC-127K	R12-127K
(26220)	698KΩ	1%, 1/2 W	MtF	IRC	CEC-698K	R94-698K
(26320)	1.4MΩ	1%, 1/2 W	MtF	IRC	CEC-1.4M	R12-1.4M
R151	100KΩ	1%, 1/2 W	DCb	DALE	DCF-1/2-100K	R12-100K
R152	*Value Selected		----	----	--------	--------
R153	2KΩ	10%, 5 W	WW	CTS	AW-2K	RP34-2K

MISCELLANEOUS

M101	Meter (less scale)	KI	CUSTOM	ME-98
PS101	Power Supply Module	PHIL	2204	Not Stocked
DS101	Pilot lamp, Neon, Red	LEE	45GR11311	PL-50
DS102	Pilot lamp, Amber	GENS	CF03ACS-1869	PL-51
DS103	Pilot lamp, Amber	GENS	CF03ACS-1869	PL-51
C109	Capacitor, 0.05μF, 600V, My	SPRAG	GPS-S50	C62-0.5M
S101	Switch, Toggle, Power	C-F	CF03ACS-1869	SW-265
S102	Switch, Calibration	ALCO	MST-105XG	SW-277
S103	Switch, Recover	GRAY	35-3	Not Stocked
S104	Switch, 117-234V	MUTER	4633-B	SW-151
F101	Fuse, 1/2A, slo-blo	BUSS	MDL-1/2A	FU-4
P105	Line Cord	ECC	4638-13	CO-5
J101	Receptacle, BNC	AMPH	31-221	CS-15
J102	Not Used	----	-------	--------
J103	Receptacle, 3-pin	ITT	XLR-3-32	CS-71
J104	Banana Jack Black	JOHN	108-903	BJ-6
J105	Plug, 15-pin	ITT	DA-15S	CS-86
J106,107	Not Used	-----	-------	--------
J108	Receptacle	-----	-------	See 4109-20
J201	Receptacle	-----	-------	See 4109-20
D101-109	Not Used	----	-------	--------
D110-112	Rectifier, 400mA, 225V	TEXAS	1N645	RF-14

TRANSISTORS

Q101-109	Not Used	-----	-------	--------
Q110	PNP	TEXAS	2N2907A	Not Stocked
Q111	PNP	TEXAS	2N2907A	Not Stocked
Q112	NPN	TEXAS	2N930	Not Stocked

REPLACEABLE PARTS LIST
MAIN CHASSIS (SCHEMATIC 25953D)

RESISTORS

Circuit Desig.	Value	Rating	Type	Mfr. Code	Mfr. Desig.	Keithley Part No.
R140	68KΩ	10%, 1/4W	Comp	A-B	CB68K-10%	R76-68K
R141	68KΩ	10%, 1/4W	Comp	A-B	CB68K-10%	R76-68K
R142	33KΩ	10%, 1/4W	Comp	A-B	CB33K-10%	R76-33K
R143	33KΩ	10%, 1/4W	Comp	A-B	CB33K-10%	R76-33K
R144	470Ω	10%, 1/4W	Comp	A-B	CB470-10%	R76-470
R145	47KΩ	10%, 1/4W	Comp	A-B	CB47-10%	R76-47K
R146	100KΩ	10%, 1/4W	Comp	A-B	CB100K-10%	R76-100K
R147	10KΩ	10%, 1/4W	Comp	A-B	CB10K-10%	R76-10K
R148	4.3KΩ	10%, 1/4W	Comp	A-B	CB4.3K-10%	R76-4.3K
R149	Not Used	------	----	----	--------	--------
R150 (26120)	127KΩ	1%, 1/2 W	MtF	IRC	CEC-127K	R12-127K
(26220)	698KΩ	1%, 1/2 W	MtF	IRC	CEC-698K	R94-698K
(26320)	1.4MΩ	1%, 1/2 W	MtF	IRC	CEC-1.4M	R12-1.4M
R151	100KΩ	1%, 1/2 W	DCb	DALE	DCF-1/2-100K	R12-100K
R152	*Value Selected		----	----	--------	--------
R153	2KΩ	10%, 5 W	WW	CTS	AW-2K	RP34-2K

MISCELLANEOUS

M101	Meter (less scale)	KI	CUSTOM	ME-98
PS101	Power Supply Module	PHIL	2204	Not Stocked
DS101	Pilot lamp, Neon, Red	LEE	45GR11311	PL-50
DS102	Pilot lamp, Amber	GENS	CF03ACS-1869	PL-51
DS103	Pilot lamp, Amber	GENS	CF03ACS-1869	PL-51
C109	Capacitor, 0.05μF, 600V, My	SPRAG	GPS-S50	C62-0.5M
S101	Switch, Toggle, Power	C-F	CF03ACS-1869	SW-265
S102	Switch, Calibration	ALCO	MST-105XG	SW-277
S103	Switch, Recover	GRAY	35-3	Not Stocked
S104	Switch, 117-234V	MUTER	4633-B	SW-151
F101	Fuse, 1/2A, slo-blo	BUSS	MDL-1/2A	FU-4
P105	Line Cord	ECC	4638-13	CO-5
J101	Receptacle, BNC	AMPH	31-221	CS-15
J102	Not Used	----	-------	--------
J103	Receptacle, 3-pin	ITT	XLR-3-32	CS-71
J104	Banana Jack Black	JOHN	108-903	BJ-6
J105	Plug, 15-pin	ITT	DA-15S	CS-86
J106,107	Not Used	-----	-------	--------
J108	Receptacle	-----	-------	See 4109-20
J201	Receptacle	-----	-------	See 4109-20
D101-109	Not Used	----	-------	--------
D110-112	Rectifier, 400mA, 225V	TEXAS	1N645	RF-14

TRANSISTORS

Q101-109	Not Used	-----	-------	--------
Q110	PNP	TEXAS	2N2907A	Not Stocked
Q111	PNP	TEXAS	2N2907A	Not Stocked
Q112	NPN	TEXAS	2N930	Not Stocked

REPLACEABLE PARTS LIST
DUAL POLARITY VERSION
AMPLIFIER MODULE (SCHEMATIC 25951C)

MISCELLANEOUS

Circuit Desig.	Description	Mfr. Code	Mfr. Desig.	Keithley Part No.
T101	Thermistor	YEL	YSI44008	Not Stocked
J102	Plug, 15-pin	ITT	DA-15P	CS-87

DIODES

Circuit Desig.	Description	Mfr. Code	Mfr. Desig.	Keithley Part No.
D101	Zener, 24V, 0.25W	DICK	1N723	DZ-17
D102	Zener, 24V, 0.25W	DICK	1N723	DZ-17
D103	Zener, 9.1V	SEMCR	1N713A	DZ-38
D104	Rectifier, 75mA, 75V	TEXAS	1N914	RF-28
D105	Not Used	----	---	---
D106	Not Used	----	---	---
D107	Rectifier, 75mA, 75V	TEXAS	1N914	RF-28
D108	Rectifier, 75mA, 75V	TEXAS	1N914	RF-28
D109	Rectifier, 75mA, 75V	TEXAS	1N914	RF-28

CAPACITORS

Circuit Desig.	Description	Mfr. Code	Mfr. Desig.	Keithley Part No.
C101	2.2 μF, 20V, ETT	UNCC	K2R2J20K	C80-2.2M
C102	2.2 μF, 20V, ETT	UNCC	K2R2J20K	C80-2.2M
C103	0.01 μF, 1000V, CerD	SPRAG	10SS-S10	C22-.01M
C104	0.01 μF, 1000V, CerD	SPRAG	10SS-S10	C22-.01M
C105	0.001μF, 1000V, CerD	SPRAG	10SS-S10	C22-.001M
C106	100 pF, 200V, Poly	ARCO	2PJ-101G	C108-100P
C107	100 pF, 1000V, CerD	CENLB	DD101-10%	C22-100P
C108	100 pF, 1000V, CerD	CENLB	DD101-10%	C22-100P

REPLACEABLE PARTS LIST
DUAL POLARITY VERSION
AMPLIFIER MODULE (SCHEMATIC 25951C)

RESISTORS

Circuit Desig.	Value	Rating	Type	Mfr. Code	Mfr. Desig.	Keithley Part No.
R101	Not Used	--	--	--	--	---
R102	10K Ω	10%, 1/4W	Comp	A-B	CB-10K-10%	R76-10K
R103	133KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-133K	R88-133K
R104	100KΩ	0.75 W	Cermet	BECK	89P-100K	R89-100K
R105	133KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-133K	R88-133K
R106	1K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-1K	R88-1K
R107	64.9KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-64.9K	R88-64.9K
R108	2K Ω	0.75 W	Cermet	BECK	89P-2K	RP89-2K
R109	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP89-200K
R110	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP89-200K
R111	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP88-200K
R112	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP89-200K
R113	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R114	*	--	--	----	--	---
R115	*	--	--	----	--	R2SI
R116	100K Ω	10%, 1/4W	Comp	A-B	CB-10K-10%	R76-100K
R117	10K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-10K	R88-10K
R118	Not Used	--	--	----	--	---
R119	*	--	--	----	--	---
R120	34.8KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-34.8K
R121	*	--	--	----	--	---
R122	10K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-10K	R88-10K
R123	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R124	*	--	--	--	--	R2NI
R125	Not Used	--	--	--	--	---
R126	*	--	--	--	--	R8NI
R127	Not Used	--	--	--	--	---
R128	*	--	--	--	--	R5NI
R129	*	--	--	--	--	R6SINI
R130	*	--	--	--	--	R7SINI
R131	*	--	--	--	--	R7SINI
R132	10K Ω	10%, 1/4W	Comp	A-B	CB-10K-10%	R76-10K
R133	470 Ω	10%, 1/4W	Comp	A-B	CB-470-10%	R76-470
R134	470 Ω	10%, 1/4W	Comp	A-B	CB-470-10%	R76-470
R135	499K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-499K	R88-499K
R136	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R137	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R138	499K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-499K	R88-499K
R139	Not Used	--	--	--	--	---

See page 14 for resistor circuit designations R140 through R153.

*Value selected during factory calibration.

REPLACEABLE PARTS LIST
DUAL POLARITY VERSION
AMPLIFIER MODULE (SCHEMATIC 25951C)

RESISTORS

Circuit Desig.	Value	Rating	Type	Mfr. Code	Mfr. Desig.	Keithley Part No.
R101	Not Used	--	--	--	--	---
R102	10K Ω	10%, 1/4W	Comp	A-B	CB-10K-10%	R76-10K
R103	133KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-133K	R88-133K
R104	100KΩ	0.75 W	Cermet	BECK	89P-100K	R89-100K
R105	133KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-133K	R88-133K
R106	1K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-1K	R88-1K
R107	64.9KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-64.9K	R88-64.9K
R108	2K Ω	0.75 W	Cermet	BECK	89P-2K	RP89-2K
R109	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP89-200K
R110	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP89-200K
R111	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP88-200K
R112	200K Ω	0.75 W	Cermet	BECK	89P-200K	RP89-200K
R113	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R114	*	--	--	----	--	---
R115	*	--	--	----	--	R2SI
R116	100K Ω	10%, 1/4W	Comp	A-B	CB-10K-10%	R76-100K
R117	10K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-10K	R88-10K
R118	Not Used	--	--	----	--	---
R119	*	--	--	----	--	---
R120	34.8KΩ	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-34.8K
R121	*	--	--	----	--	---
R122	10K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-10K	R88-10K
R123	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R124	*	--	--	--	--	R2NI
R125	Not Used	--	--	--	--	---
R126	*	--	--	--	--	R8NI
R127	Not Used	--	--	--	--	---
R128	*	--	--	--	--	R5NI
R129	*	--	--	--	--	R6SINI
R130	*	--	--	--	--	R7SINI
R131	*	--	--	--	--	R7SINI
R132	10K Ω	10%, 1/4W	Comp	A-B	CB-10K-10%	R76-10K
R133	470 Ω	10%, 1/4W	Comp	A-B	CB-470-10%	R76-470
R134	470 Ω	10%, 1/4W	Comp	A-B	CB-470-10%	R76-470
R135	499K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-499K	R88-499K
R136	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R137	100K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-100K	R88-100K
R138	499K Ω	1%, 1/8 W	MtF	IRC	CEA-TO-499K	R88-499K
R139	Not Used	--	--	--	--	---

See page 14 for resistor circuit designations R140 through R153.

*Value selected during factory calibration.

REPLACEABLE PARTS LIST
DUAL POLARITY VERSION
AMPLIFIER MODULE (SCHEMATIC 25951C)

TRANSISTORS

Circuit Desig.	Type	Mfr. Code	Mfr. Desig.	Keithley Part No.
Q101	Selected*, PNP Type	TEXAS	2N2907A*	Not Stocked
Q102	Selected*, NPN Type	TEXAS	2N930*	Not Stocked
Q103, 105	FET Matched Pair	KI	Selected	20933
Q104	Selected*, NPN Type	TEXAS	2N930*	Not Stocked
Q105	See above	----	---	----
Q106	NPN	TEXAS	2N930	Not Stocked
Q107	PNP	TEXAS	2N2907A	Not Stocked
Q108	NPN	TEXAS	2N930	Not Stocked
Q109	PNP	TEXAS	2N2907A	Not Stocked

INTEGRATED CIRCUITS

Circuit Desig.	Type	Mfr. Code	Mfr. Desig.	Keithley Part No.
QA101	Operational Amplifier	NAT	LM301AH	IC-2
QA102	Operational Amplifier	NAT	LM301AH	IC-2
QA103	Operational Amplifier	NAT	LM301AH	IC-2

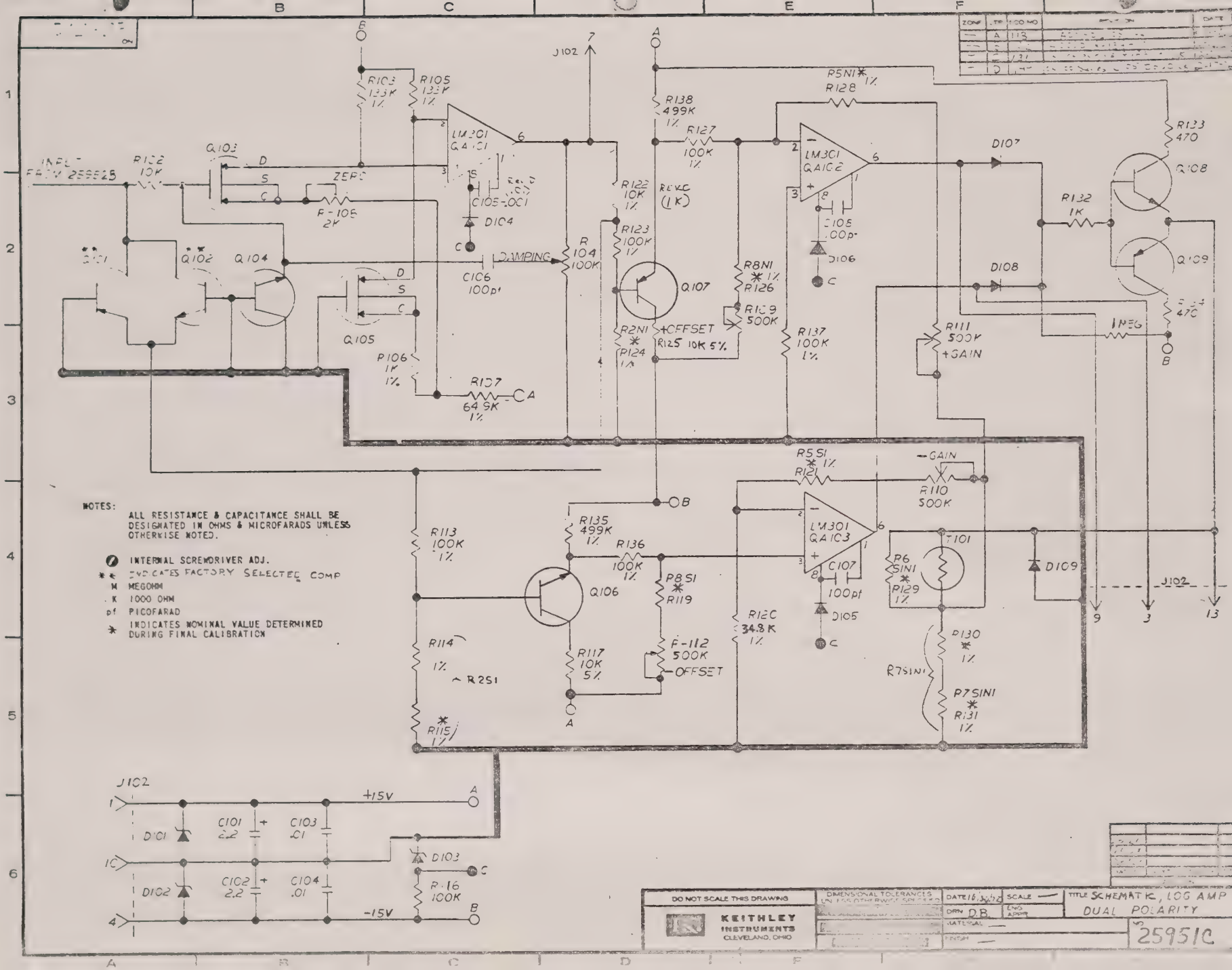
REPLACEABLE PARTS LIST
INPUT SWITCHING (SCHEMATIC 25952B)

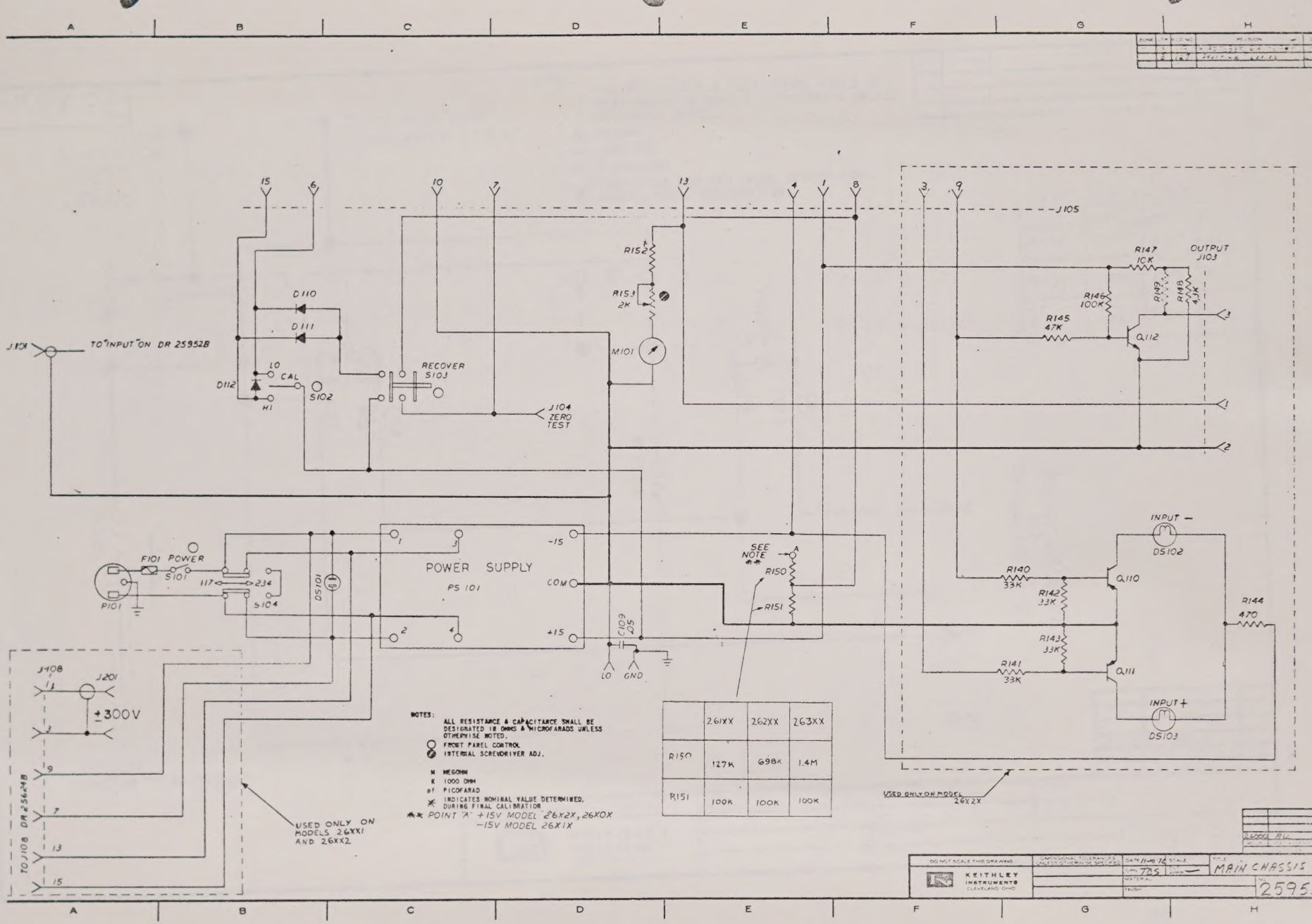
RESISTORS

Circuit Desig.	Value	Rating	Type	Mfr. Code	Mfr. Part No.	Keithley Part No.
R101	$10^{10}\Omega$	------	GCb	VICT	RX-1-10^{10}	R20-10^{10}
R102	10K Ω	1%, 1/2 W	DCb	DALE	DCF-1/2-10K	R12-10K
R103	10K Ω	10%, 1/2W	Comp	A-B	EB-10KΩ	R1-10K
R104	390 Ω	10%, 1/4W	Comp	A-B	CB-391-10%	R76-390
R105	390 Ω	10%, 1/4W	Comp	A-B	CB-391-10%	R76-390

Cross-Reference of Manufacturers

ABREV.	NAME AND ADDRESS
A-B	Allen-Bradley Corp. Milwaukee, WI. 53204
ALCO	Alco Switch Lawrence, MA. 01842
AMPH	Amphenol Corp. Broadview, IL. 60153
AMPRX	Amprex Elkgrove Village, IL. 60007
ARCO	Arco Electronics, Inc. Great Neck, NY. 11022
BECK	Beckman Instruments, Inc. Fullerton, CA. 92634
BUSS	Bussmann Mfg. Co. St. Louis, MO. 63107
CENLB	Centralab Division Milwaukee, WI. 53201
C-F	Circle-F Industries Trenton, NJ. 08604
CTS	CTS Corporation Elkhart, IN. 46514
DALE	Dale Electronics, Inc. Columbus, NB. 68601
DICK	Dickson Electronics Corp. Scottsdale, AZ. 85052
ECC	Electric Cord Company Fairfield, NJ. 07006
ERIE	Erie Technological Products Erie, PA. 16512
FAIR	Fairchild Instrument Corp. Mountain View, CA. 94040
GENS	Genisco Technology Corp. Compton, CA. 90221
GRAY	Grayhill, Inc. La Grange, IL. 60525
IRC	IRC Division Burlington, IA. 52601
ITT	ITT Cannon Electric, Inc. Los Angeles, CA. 90031
JOHN	Johnson E. F. Company Waseca, MN. 56093
KI	Keithley Instruments, Inc. Cleveland, OH. 44139
LEE	Leecraft Mfg. Co., Inc. Long Island City, NY. 11101
MOLEX	Molex Douners Grove, IL. 60515
MOT	Motorola Products Inc. Phoenix, AZ. 85008
MUTER	Muter Company Chicago, IL. 60638
NAT	National Semiconductor Corp. Santa Ciara, CA. 95051
PHIL	Teledyne Philbrick Dedham, MA. 02026
POTT	Potter Company Wesson MS. 39191
SEMCR	Semcor Division Phoenix, AZ. 85019
SPRAG	Sprague Electric Co. North Adams, MA. 01247
RCA	RCA Corporation Somerville, NJ. 08876
S-T	Sarkes Tarzian Inc. Bloomington, IN. 47401
TEXAS	Texas Instruments, Inc. Dallas, TX. 75231
UNCC	Union Carbide Corp. New York, NY. 10017
VICT	Victoreen Instrument Co. Cleveland, OH. 44103
YEL	Yellow Springs Company Yellow Springs, OH. 45387


NOTES:
ALL RESISTANCE & CAPACITANCE SHALL BE DESIGNATED IN OHMS & MICROFARADS UNLESS OTHERWISE NOTED.
INTERNAL SCREWDRIVER ADJ.
** INDICATES FACTORY SELECTED COMP
M MEGOHM
K 1000 OHM
pf PICOFARAD
* INDICATES NOMINAL VALUE DETERMINED DURING FINAL CALIBRATION
INPUT FROM 2559-28
R102 10K
Q103
ZERO
R-105 2K
R103 133K 1%
R105 133K 1%
LM301 QA1C1
C105 .001
D104
C106 100pf
DAMPING
R104 100K
Q101
Q102
Q104
Q105
P106 1K 1%
R107 64.9K 1%
R122 10K 1%
RESP (1K)
R123 100K 1%
Q107
R2NI *OFFSET
P124 1K
R125 10K 5%
R138 499K 1%
R127 100K 1%
R5NI* 1%
R128
LM301 QA1C2
C105 100pf
D106
R8NI* 1% R126
R129 500K
R137 100K 1%
D107
D108
R123 470
Q108
R132 1K
Q109
R124 470
INEG
R111 500K +GAIN
B
R5SI* 1%
R121
-GAIN
R110 500K
R113 100K 1%
R135 499K 1%
R136 100K 1%
Q106
P8SI* R119
R114 1% R2SI
R117 10K 5%
F-112 500K -OFFSET
R115* 1%
R12C 34.8K 1%
LM301 QA1C3
C107 100pf
D105
T101
P6SINI* P129 1%
D109
J102
9
3
13
P130* 1%
R7SINI
P7SINI* R131 1%
J102
+15V
-15V
D101
D102
D103
C101 2.2
C102 2.2
C103 .01
C104 .01
R-16 100K
DO NOT SCALE THIS DRAWING
KEITHLEY INSTRUMENTS CLEVELAND, OHIO
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
DATE 10 July 70
SCALE —
DRN D.B.
ENG APPR.
MATERIAL —
FINISH —
TITLE SCHEMATIC, LOG AMP DUAL POLARITY
25951C



NOTES:

ALL RESISTANCE & CAPACITANCE SHALL BE DESIGNATED IN OHMS & MICROFARADS UNLESS OTHERWISE NOTED.

⊙ FRONT PANEL CONTROL

⊘ INTERNAL SCREWDRIVER ADJ.

M MEGOHM
K 1000 OHM
pf PICOFARAD

* INDICATES NOMINAL VALUE DETERMINED DURING FINAL CALIBRATION

** POINT "A" +15V MODEL 26X2X, 26XOX
−15V MODEL 26X1X

	261XX	262XX	263XX
R150	127K	698K	1.4M
R151	100K	100K	100K

KEITHLEY INSTRUMENTS CLEVELAND OHIO

DO NOT SCALE THIS DRAWING

DATE 11-10-76 SCALE —

DWG 725

MATERIAL

FINISH

MAIN CHASSIS

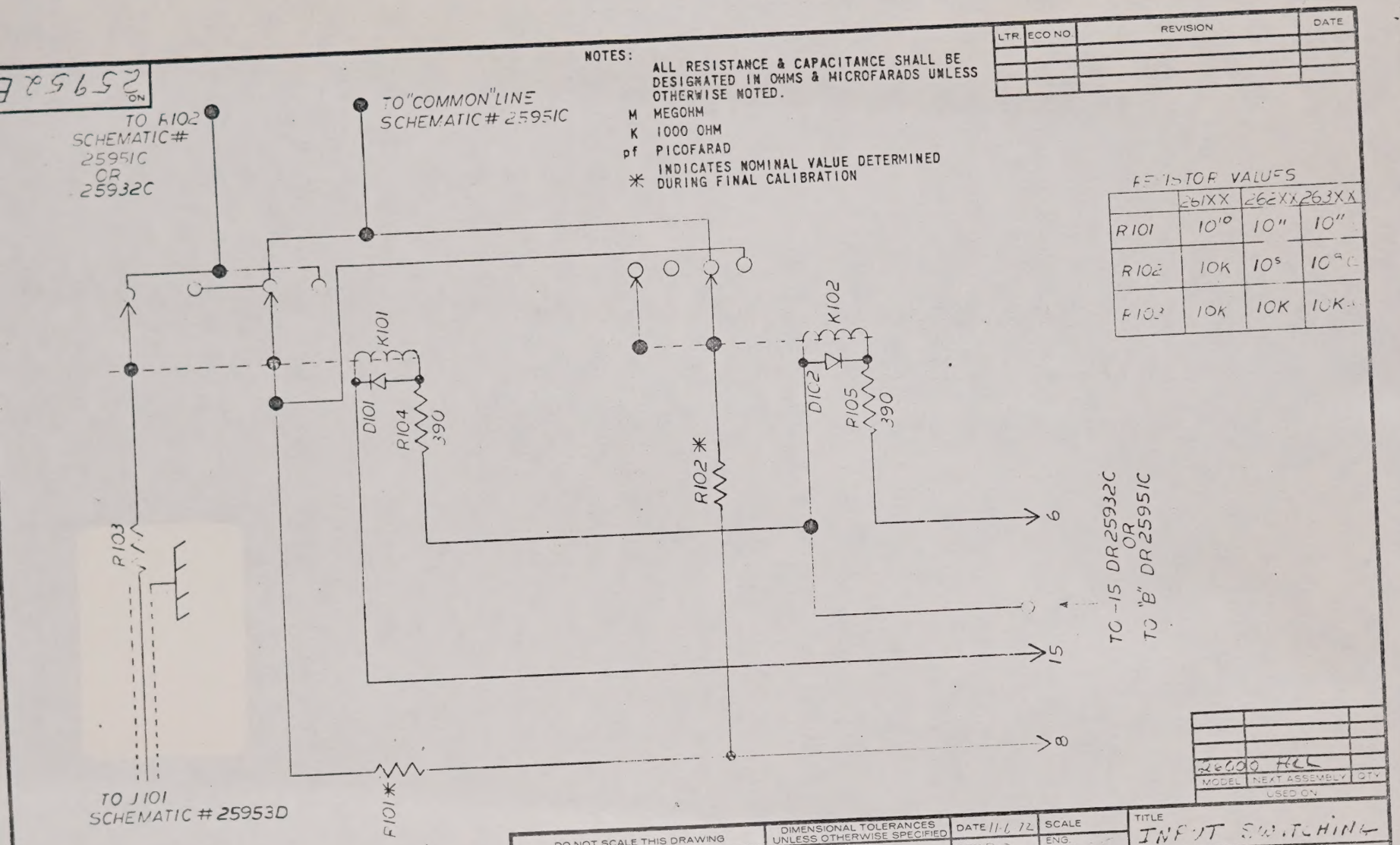
2595

LTR	ECO NO.	REVISION	DATE

NOTES:

ALL RESISTANCE & CAPACITANCE SHALL BE DESIGNATED IN OHMS & MICROFARADS UNLESS OTHERWISE NOTED.

M MEGOHM
K 1000 OHM
pf PICOFARAD
* INDICATES NOMINAL VALUE DETERMINED DURING FINAL CALIBRATION



RESISTOR VALUES

	261XX	262XX	263XX
R101	10^{10}	10^{11}	10^{11}
R102	10K	10^{5}	10^{9}
R103	10K	10K	10K

MODEL	NEXT ASSEMBLY	QTY
26000 REL		

USED ON

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 11-6-72	SCALE	TITLE INPUT SWITCHING
KEITHLEY INSTRUMENTS CLEVELAND, OHIO		DRN	ENG. APPR.	
		MATERIAL		NO. 25952B
		FINISH		

MP MASTER
MA29126